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Introduction of Renewable Energy Certificate in the Indian scenario

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ABSTRACT

Generation deficit in India is in the range of 9% and the scenario is expected to get grimmer in the context of high growth rate of the country. With peak power shortage as high as 15.2% (*Source*: Annual report FY08, MoP) the nation needs to harness all forms of generation including renewables, which currently has a meager share of 8% of the total generation in the country at present. Shooting price of crude oil reaching up to $135 (May 2008) per barrel along with increasing awareness and concerns about environment, the stage seems to be set for an increased mix of Renewable Energy (RE) into the overall energy requirement in the country. Keeping the concern for environment and energy security for the country in mind, government of India has been putting emphasis on promotion of renewable energy sources. Central and state government policies have always been instrumental in the propagation of capacity additions in renewable energy power. One of the main aims of these policies has been on increasing the private sector participation in this sector. In the pre-reform period, the state governments took policy decisions regarding financial incentives, buy-back tariff and other measures targeting investment in renewable energy. However, the State Electricity Regulatory Commissions (SERCs) are now responsible for many of these tasks. SERCs have come up with a host of initiatives, inline with their functions laid down in the Electricity Act 2003, to increase the share of renewable energy inside their respective States. Despite the efforts of SERCs, large potential of renewable energy generation remains untapped. There is lack of clarity on how to promote renewable energy generation inside states which are not having significant renewable energy generation potential.

This paper explores the way in which SERCs can introduce measures to further promote renewable energy generation inside the country. We discuss in detail the framework to promote renewable energy through a framework which puts into place Renewable Purchase Obligation (RPO) mechanism. The framework includes setting of RPO targets, provisions for a surcharge levied upon non-compliance of RPO targets and also a mechanism to meet RPO through trading of certificates.

Contents

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1. Introduction

In the recent past India has been growing at an average rate of 8.5%. Growth of economy is reciprocally linked to energy usage, and consequently the energy requirements of the country have increased phenomenally in the last couple of years. Over the years, Indian power sector has experienced a four-time increased in its installed capacity—a jump from 30,000 MW in 1981 to over 143,000 MW by March 2008.

As illustrated in Fig. 1, around 64% of electricity generation is thermal based while the contribution from renewable energy is about 8% of the total installed capacity. It can be noted that approximately 70% of the total oil requirement in India is imported. Higher dependence on oil imports and dominant share of thermal based generation, which is again dependent on fast depleting coal reserves, lead to the concern for energy security for the country. Renewable energy has the potential for mitigating environmental threats and energy insecurity, as the country is endowed with huge non-conventional based generation potential. As per the Ministry of New and Renewable Energy (MNRE)[1] the potential for generation of electricity through renewable energy sources is 84,777 MW. Moreover, 70% of people burn biomass for meeting energy requirements for cooking and heating in the country. Policies of the Central and State level government are direct and conscious efforts to break with the import dominant generation to environmentally benign, indigenous and sustainable form of generation. One of the main aims of these policies has been on increasing the private sector participation in the energy sector. In the pre-reform period, with an objective to promote renewable energy in the state, State governments took policy decisions in form of incentives, buy-back tariffs and other benefits. With the advent of the Electricity Act 2003 (E' Act 2003) and other policies (National Electricity Policy and National Tariff Policy) State Electricity Regulatory Commissions (SERCs) appears to be in the helm of affairs for the promotion of renewable energy at the state level. The E' Act 2003 has assigned the responsibility of promoting Renewable Energy (RE) power to SERCs. As per the Act, SERCs are required to encourage investment in RE by providing suitable measures for connectivity with the grid and specify a percentage of the total consumption of electricity in the area of a distribution license to be procured from RE sources. Roles of different stakeholders and promotional measures defined under the E' Act 2003, National Tariff Policy, National Electricity Policy and National Rural Electrification Policy are discussed as follows:

[1] Electricity Act 2003 [3]

(a) Section 86 (1) (e)—"The State Commission shall discharge the following functions, namely: promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution license."

(b) Section 61 (h)—"The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely: the promotion of co-generation and generation of electricity from renewable sources of energy."

[2] National Electricity Policy (NEP) 2005

(a) "Feasible potential of non-conventional energy resources, mainly small hydro, and wind and bio-mass would also need to be exploited fully to create additional power generation capacity. With a view to increase the overall share of non-conventional energy sources in the electricity mix, efforts will be made to encourage private sector participation through suitable promotional measures."

(b) "Non-conventional sources of energy being the most environment friendly there is an urgent need to promote generation of electricity based on such sources of energy. For this purpose, efforts need to be made to reduce the capital cost of projects based on non-conventional and renewable sources of energy. Cost of energy can also be reduced by promoting competition within such projects. At the same time, adequate promotional measures would also have to be taken for development of technologies and a sustained growth of these sources."

(c) "Percentage for purchase of power from non-conventional sources should be made applicable for the tariffs to be determined by the SERCs at the earliest. Progressively the share of electricity from non-conventional sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the Commission may determine an appropriate differential in prices to promote these technologies."

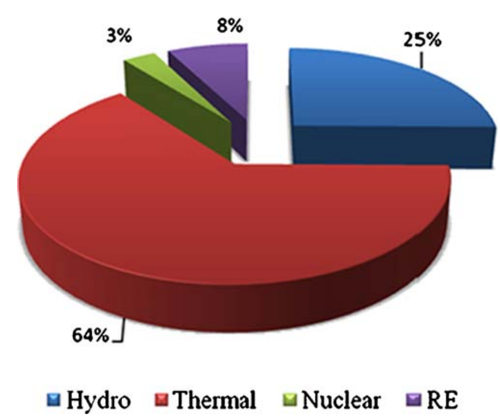


Fig. 1. Technology-wise distribution of installed capacity in India (*Source*: Ministry of Power, India).

[1] The ministry was the first dedicated ministry in the world for the promotion of renewable energy. MNRE formulates policy measures at the central level and gets programs implemented through State Nodal Agencies (SNA), which are setup at state level.

[3] National Tariff Policy (NTP) 2006
(a) "Tariff fixation for all electricity projects (generation, transmission and distribution) that results in lower Green House Gas emissions than the relevant base line should take into account the benefits obtained from the Clean Development Mechanism into consideration, in a manner so as to provide adequate incentives to the project developers."
(b) "The Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs."
(c) "Such procurement by Distribution Licensees for future requirement shall be done as far as possible through competitive bidding process under section 63 of the Act within the suppliers offering energy from same type of nonconventional sources."
[1] National Rural Electrification Policy (NREP) 2006
(a) "For villages/habitations, where grid connectivity would not be feasible or not cost effective, off-grid solutions based on standalone systems may be taken up for supply of electricity so that every household gets access to electricity. Where neither standalone systems nor grid connectivity is feasible and if only alternative is to use isolated lighting technologies like solar photovoltaic, these may be adopted."

Cognizant of its role in the promotion of RE, SERCs in many states have had been formulating encouraging policies to promote renewable energy. Measures by SERCs include preferential tariffs, Renewable Purchase Obligations (RPO), reduction in contract load, banking and wheeling arrangements and guidelines for evacuation arrangement. Fig. 2 highlights the technologies for which respective SERCs have declared preferential tariff orders.

SERCs have set targets for the Eligible Consumers (ECs; defined as consumers, on whom the RPO applies). Eligible Consumers (ECs) typically include distribution licensee (Discoms) while some SERCs have also applied the RPO on the Open Access Consumers (OAC) and Captive Power Plant (CPP) consumers as well. Along with specifying a minimum RPO, certain SERCs have also set a ceiling for maximum power that can be purchased by the Discoms from the RE sources in order to keep a check on increase in retail tariff due to higher power purchase costs.

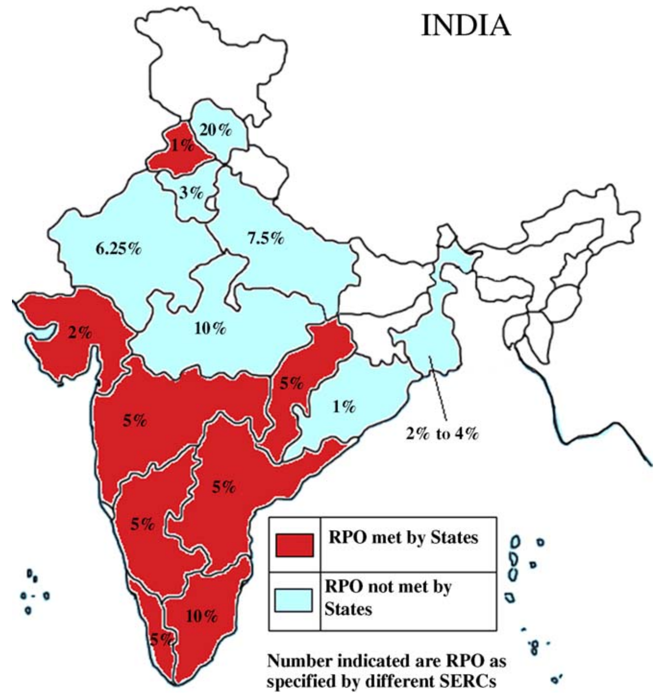


Fig. 3. Snapshot of state-wise policies (minimum RPO obligation numbers for FY09) (*Source*: Respective SERC orders).

In order to ensure compliance to the RPO as specified by SERCs, a provision to levy a renewable surcharge (penalty) on the ECs upon falling short of RPO target is kept in certain states (Rajasthan and Maharashtra). Funds collected under this head are earmarked for the promotion of RE sources. Fig. 3 provides a snapshot of state-wise policies as well as compliance to these policies and Table 1 provides a snapshot of policy decisions taken by SERCs in some of the key States.

A total of 15 states have specified RPO and out of these 15 states, consumers of 8 states have shown compliance to the specified RPO targets. While the country has the unique distinction of having an entire ministry (MNRE) dedicated to

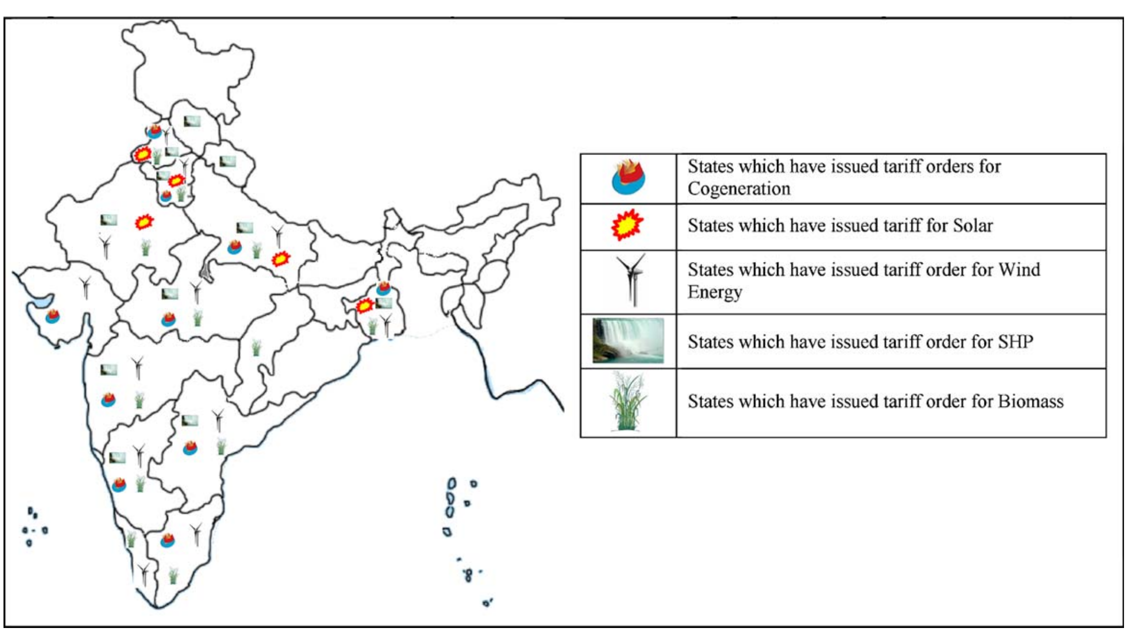


Fig. 2. Preferential tariff orders declared by SERCs for different technologies (*Source*: Respective SERC orders) [1,2,4–11,13,17–20].

Table 1
Snapshot of policy decisions of different SERCs [12,15,16].

	Maharashtra	Karnataka	Gujarat	Andhra Pradesh	Rajasthan	Madhya Pradesh
RPO (FY09)	5%	5%	2%	5%	6.25%	10%
Maximum purchase specified	No	Yes	No	No	Yes	No
RPO on CPP and OAC	Yes	No	No	Yes	Yes	No
Penalty levied (Rs/kWh)	5	No	No	Yes	3.59	No
Penalty paid to	MEDA	NA	NA	–	STU	NA
Obligation trading mechanism (REC)	Yes	No	No	No	No	No

Source: Respective SERC tariff orders.

the renewable energy sector and also having put in place enabling policy measures, India has had tapped only about 13% of the total potential (84,776 MW) that has been mapped for renewable energy inside the country.

States like Madhya Pradesh and Uttar Pradesh have been able to procure only 0.1% and 2.5% of total energy requirement against a target of 10% and 7.5% respectively. States like Haryana and Himachal Pradesh have also fallen considerably short of their RPO targets. Specifying RPO targets alone would not serve the purpose of promoting RE, rather a suitable mechanism to ensure compliance to such targets warrants to be put in place.

Typically SERCs (APERC, KERC, KSERC, etc.) have asked utilities to procure RE from inside the State only to meet the RPO. Certain SERCs, like HERC, have not clarified whether renewable energy has to be procured from sources inside the State whereas certain States like Punjab allow the utilities to procure power from neighboring to meet their RPO targets.

There are states in India with low potential for renewable energy as compared to other states. When the RPO is fixed on the basis of total potential available, these states with low potential of renewable might not be able to contribute to the goal of the nation to achieve 10% of total energy requirement from renewables. Obligation is generally fixed by assigning a percentage for procurement from RE sources of the total electricity purchased by Discoms. However, States with no potential or low potential do not come under any obligation as there is no mechanism facilitating inter-state transaction of power from renewable sources. The paper attempts to present a compliance mechanism that could help all states in India contribute to promotion of renewable energy.

The paper tries to suggest a mechanism which SERCs can put in place to ensure compliance. The suggested framework includes the provision of Renewable Energy Certificates (RECs) trading in order to help the ECs meet their obligation in an easier and more flexible way. The proposed framework is discussed in the following sections.

2. Framework to promote renewable energy

2.1. Renewable Purchase Obligation

RPO is a compulsion on the EC to procure a certain percentage of their total power purchase during a financial year from the renewable energy sources. While specifying the RPO obligation, respective SERCs should take a look at the following factors:

[1] Projections of total quantum of energy required for sale in the State in near future.
[2] Total potential for different types of renewable energy in the State.
[3] Quantum of energy currently being generated by renewable energy generator inside the State.
[4] Commercial impact of renewable power on the retail tariff.
[5] Technical impact of renewable energy generator on the state grid.
[6] Overall target as specified by the Central Govt. policies.

SERC should set realistic achievable targets taking into account the lead time in development of different RE technologies. Once the RPO targets are specified then the SERCs need to identify the EC on which the RPO obligation would be levied. Different states have taken a different view on this issue. All the 15 states have included the Discoms in the list of ECs. However, only 3 states out of the total of 15 states have included the OAC and CPP consumers in the list of eligible consumers.

It is proposed that RPO should also be levied on the OAC and CPP consumers. Section 86(1) (e) of the Electricity Act 2003 states that "Commission is to provide suitable measures for connectivity to grid and sale of electricity to any person." Here the emphasis on "any person" is to be noted. The term *person* has very wide meaning as has been defined in the Electricity Act and includes any company or corporate body or association or body of individuals or artificial juridical person. Suitable measures are to be provided using regulatory mechanism so that renewable energy can be sold to any person and not to the Discoms alone. Regulation levying RPO is one such measure for providing consumption/use of renewable energy by any person, i.e. captive/OA consumers and hence should apply to OAC and CPP consumers as well.

Also, the word licensee assumes importance because the distribution licensee has been endowed with the responsibility of universal supply obligation. Had the power consumed by CPP/OAC been not arranged by the CPP consumers or through open access then as per the supply obligation this power would have to be supplied by the licensee and in such a case the purchase of renewable energy to a certain percentage would have been obligatory. There cannot be any discrimination amongst normal consumers and captive/OA consumers, so far as the share of renewable energy consumption is concerned.

The spirit of the Act and the relevant provision is thus clear that such percentage has to be specified on the total consumption of electricity and not the consumption as a consequence of sale by distribution licensee only. However, RPO on OAC and CPP consumers should exclude consumers with very low consumption levels in order to make the compliance mechanism simple and executable. For example, consumers with consumption of 5 MUs (having a demand of approximately 1 MW) and less can be excluded from RPO compliance mechanism as it would lessen the burden of monitoring and implementing the RPO framework. Comparison of cost of administering RPO mechanism with different set of complexity is provided in Ref. [23]. Cost of administration can be significantly reduced if consumer with lower consumption can be excluded from the RPO framework.

2.1.1. Calculation of RPO

SERCs need to develop a common practice for the calculation of RPO from the perspective of an individual consumer. This would

provide a level playing platform for renewable energy investor in all the States. Following formulae can be used to calculate the total quantum of energy to be procured from renewable energy:

[1] Discom: RE to be procured = $\eta\tau$
[2] OAC: RE to be procured = $\kappa\tau$
[3] CPP consumers: RE to be procured = $\lambda\tau$

where η = metered annual LT sales + metered annual HT sales; κ = actual energy consumption as per the SEM meter installed at the Discom-OAC interface; λ = net captive energy consumption as per the SEM meter installed at the Discom–Captive interface + energy consumed from captive installed inside premises; τ = target % for renewable energy for the ensuing year).

2.2. Renewable Energy Surcharge (RES)

A mechanism can be introduced imposing RES on ECs for falling short of the RPO, which could drive ECs to strive and meet the RPO target. However, SERCs have so far shown reluctance in introducing RES citing reasons such as (i) absence of adequate potential within the state and (ii) lukewarm response from developers due to lower tariffs for renewable based generation. Surcharge of this nature has already been experimented in a couple of states in India, namely Maharashtra and Rajasthan.

One can argue that the EC should not be penalized for falling short of their RPO targets due to lack of renewable based generation capacity in the state, as it is not the responsibility of the utilities to rope in developers. Also, one can question why States which do not have sufficient potential for RE generation should have a provision for RES for ECs.

Questions raised above can be explained by understanding that by specifying an RPO, SERCs are effectively asking the EC to bear an additional premium cost on a certain percentage of their power purchase. Such a premium cost is towards the promotion of renewable energy generation. If the EC are unable to bear this additional cost by purchasing RE power, they should bear the same amount by paying a surcharge towards a fund to an agency which can use the fund for renewable energy promotion.

In order to calculate the RES, we need to take a look at the premium price ECs would pay towards the procurement of power from the RE sources inside the state. Premium price is basically the difference in the cost of procurement from renewable energy source and the cost of procurement from the costliest generation in EC's portfolio. Premium price would basically be the cost avoided by not procuring from renewable energy sources.

RES applicable to consumers is proposed to be higher than the premium price which otherwise EC would have paid towards the procurement of power from the costliest renewable energy sources. This would ensure that the EC make an active effort to purchase renewable energy rather than simply incurring the premium cost.

In order to calculate the premium cost for an EC, details on the cost of procurement from an RE source and cost of procurement from the costliest conventional generation are required. These numbers would be different for different ECs and hence premium cost figure for each EC would vary. RES directly linked to the premium price of an individual EC would lead to complexity in the whole mechanism along with issues in monitoring the premium price of each individual EC. Hence, it is suggested that premium cost for the state utility should act as a benchmark for all the EC. Premium cost can be the difference between the SERC approved costliest RE tariff and the procurement price from the costliest conventional generation.



Fig. 4. Graded RES structure.

There can be two ways to calculate the premium price:

(a) Premium price I = $\alpha - \beta$
(b) Premium price II = $\mu - \beta$

where α = SERC approved tariff of the costliest renewable energy source in the state for the concerned year; β = per unit cost of the last generating station in merit order despatch for the state for the concerned year; μ = SERC approved levelised tariff of costliest renewable energy source in the state.

RES can be proposed as *n* times higher than the premium price, where *n* can vary from 10% to 25%. Also, a graded RES can also be looked at wherein RES for falling short of target by 80% would be higher than RES for falling short of RPO targets by 20%. Fig. 4 shows the RES structure which can be looked at as an example.

Once the figure for RES has been arrived at, then the SERCs need to decide whether the RES is to be in form of a penalty for the state utilities (Discoms) or not. SERCs may take a look at the current capacity of the state utilities to meet the RPO targets. Considering the lead time in development of RE sources and the response shown by the RE developers, SERCs can decide a certain control period for which any payment due towards RES can be a pass through in the Annual Revenue Requirement (ARR) of the state utilities. However, once the state utilities are given enough time to comply to the RPO targets, it is proposed that RES payable should not be a pass through item in the utilities ARR. It would be the onus of the SERCs to take a call of the appropriate time for the compliance to the RPO. SERCs may like to assess the procedures required in the State for setting up renewable energy sources, support from governments and financial condition of ECs while determining the minimum required period for compliance in which RES would be a pass through in ARR.

States are likely to generate cash flows through RES mechanism in situations wherein the ECs are unable to meet the RPO targets. A fund can be created from the cash generated through RES which can further be merged with any Green Fund or Renewable Energy Fund setup inside the states, for renewable energy development. The fund can be utilized towards removing the critical barriers for the renewable energy sources such as (a) creating evacuation infrastructure for power generated, (b) providing guarantee to developers to take care of intermittency in RE generation, (c) research and development of RE sources, (d) institutional capacity building of State Nodal Agency (SNA), SERC, developers and other stakeholders, and (e) public awareness related to renewable energy.

2.3. Renewable Energy Certificates

RECs are basically a market-based instrument to promote RE and facilitate procurement obligations. All over the word it is fast emerging as the aggregation of non-energy and socially beneficial attributes (environmental and socio-economic attributes). Standardized certificates i.e. REC is also being used as the evidence of renewable energy generation and consumption. An EC needing to

demonstrate compliance to RPO would need to own a certain number of REC. This would provide a market for renewable energy, which will be independent of actual electricity sales.

SERC would have to decide upon the following issues while finalizing the RPO framework:

[1] Issuing and monitoring of REC market.
[2] Features of REC.
[3] Pricing mechanism of REC.
[4] Utilization mechanism of revenue generated by the state utilities through REC trading.
[5] Safeguarding the interests of public utilities.

2.3.1. Issuing and monitoring of REC market

The very first question that arises in that who should the REC be issued to. REC typically signifies that a unit of electricity has been generated/consumed from a renewable energy source. RECs, in the Indian context, are proposed to be issued to renewable energy consumers. However, it may be noted that in most of the cases in the countries like USA, Australia and UK, RECs are issued to generators and not to consumers. As per Ref. [21], in Australia "Renewable energy certificates can only be created by eligible accredited renewable energy generators and are equivalent to one megawatt hour of renewable electricity. This creates the supply side of the market. Through the market, liable entities can trade directly or indirectly with certificate producers to acquire certificates to meet their liability." Difference in these two approaches emanates from the fact that in these markets there is no premium on the purchase price of renewable based generation compared to conventional generation, the situation is different in the Indian context. In India, due to the regulatory provision of preferential tariffs for renewable based generation, it enjoys a premium over conventional form of generation, which is generally borne by EC. With an objective to compensate the premium paid by ECs, it will be meaningful if RECs are issued to ECs, enabling them to re-distribute the premium cost by selling extra RECs (after meeting their own obligation) available with them.

Next arises the question as to which agency would administer and monitor the REC market. The agency responsible for issuing and monitoring of REC would require data on the annual metered consumption of the EC as well as it should have the capacity to provide a platform where REC can be traded. Potential candidates who can perform this function include the State Nodal Agency, the agency which is responsible for the development of renewable energy in the state. State Load Despatch Center (SLDC) can be another appropriate agency to undertake these activities as it has access to electricity trading details of all ECs.

SLDC has the advantage of having:

- Access to data in order to identify the ECs.
- Access to consumption data and consumption pattern for each EC.
- Adequate human resources and capacity to undertake the assignment.

2.3.2. Features of REC

There are many features and specifications of REC which need to be clearly defined before setting up the market. Some of the features are discussed as follows:

- REC to be issued against consumption of how many units.
- REC trading to be electronic or via papers.
- REC issuing frequency (monthly, quarterly or half-yearly).
- Banking period and limit of the REC.
- Expiry period for REC.

Above features can be decided upon by the SERCs depending upon the demand and supply of REC, quantum of REC in the market, expected number of ECs, etc.

2.3.3. Pricing mechanism of REC

There can be various pricing mechanism for trading of REC. The way SERCs determine tariff for procurement of power from renewable sources, SERCs can also fix the trading price of REC. Alternatively it can propose a floor price of REC or even a ceiling price of REC. Another mechanism can be to leave it on the market forces to decide the price where buyers and sellers would trade REC at a mutually agreed price, as it is traded in some other countries.

It would be prudent if pricing is left for the open market to determine. In such a case, pricing would be influenced by the RES determined by the SERCs. Once the SERCs determine the RES, ECs would have to analyze and determine whether they wish to purchase renewable energy by entering into a PPA with the generator or whether they wish to purchase REC and meet their RPO targets. In the latter case, ECs would be willing to procure REC as long as cost of REC is less than the RES. Another scenario for ECs can be that it neither procures power procured from renewable sources nor it purchases RECs. This case would lead to penalty charge on EC and the collection thus generated contributes to an RE fund, especially created for the promotion of renewable energy.

By putting in place the RPO, RES and REC framework, an EC would be provided with an option to promote renewable energy by either (i) procuring renewable energy directly, (ii) purchasing REC from another EC or (iii) contributing money to an RE fund by incurring RES (Fig. 5).

2.3.4. Utilization mechanism of revenue generated by the state utilities through REC trading

There can be three cases for a Discom(s) from the perspective of RPO: (i) Discom(s) might be able to generate surplus cash by selling REC, or (ii) Discom(s) may incur extra cost by purchasing REC, or (iii) Discom(s) pays penalty. In either of these cases, SERCs need to

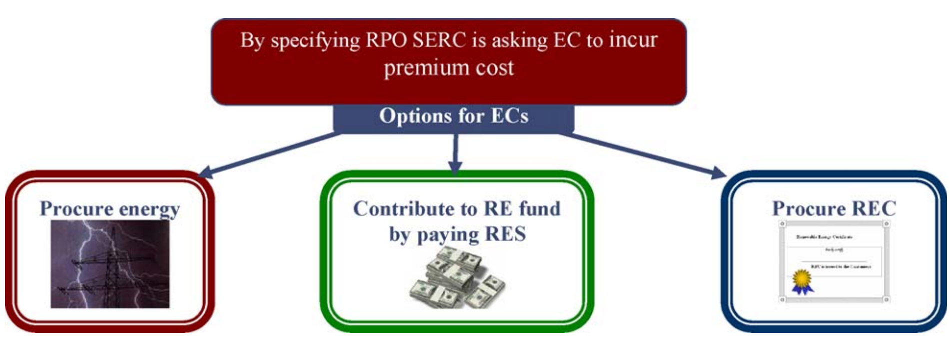


Fig. 5. Options available to an EC as per the framework proposed.

determine how the cash flows would be adjusted in the balance sheet of the Discom(s).

It can be proposed that the Discom(s) would pass through the cash generated from the sale of REC to its consumers. However, if the Discom is purchasing REC, then in the initial years (a control period provided as a cushion for the Discom to comply with the SERC order) the Discom can be allowed to pass the total cost for procurement of RECs. However, once the mechanism is well established then the Discom would be allowed to only pass the cost equivalent to the premium price of the REC which were purchased to meet the minimum obligation. Any amount paid over and above the premium price for the REC, incurred in form of penalty shall not be passed onto the consumers of the State.

2.3.5. Safeguarding the interests of the public utilities

In India, the retail tariff for the domestic category consumers is cross-subsidized through higher tariffs paid by industrial/HT consumers. HT consumers have the option of shifting to captive consumption based on renewable energy generation. However, such an option is not much attractive because of higher cost of generation for renewable energy. Still many industrial consumers have shifted to consumption from RE generation due to various incentives available.

If the SERCs decide to implement the RPO framework as discussed in this paper, then the industrial consumers can benefit from the sale of REC and can bring down the average cost of procurement from the renewable sources by the amount at which the REC are trading. However, if HT consumers are allowed to keep all REC's sale proceeds then it might have a negative impact on the Discom(s). It may lead to a situation wherein HT consumers would take the renewable based captive consumption route which would lead to a loss in cross-subsidy for the Discom. This would have an overall negative impact on the State.

A careful analysis of potential impact on Discom(s) due to implementation of RPO framework needs to be done in order to ensure that there is not much cross-subsidy loss to the Discom(s) who have universal service obligation. Under this obligation Discom(s) are obligated to serve to lesser paying consumers such as agriculture and domestic (especially rural) consumers. SERCs can look at the following options to take care of such a situation:

- REC can be **traded** *only* for *additional capacity* setup after the RPO framework was put into place. However, REC can still be issued for generation sources setup prior to the setting up of RPO framework. This would ensure that HT consumers, who are presently having significant amount of RE in their portfolio, do not extract huge benefits as the cost of state utilities (Discom).
- To limit the extent to which HT consumers can benefit, it can also be proposed that a certain portion from the proceeds of the sale of RECs can be earmarked for a state fund maintained with State Transmission Utility (STU) for promotion of renewable energy. Proceeds collected under this head can be clubbed with the proceeds collected from penalty levied on eligible consumers for falling short of the minimum procurement requirement. SERCs would need to determine the period for which the provision for sharing of proceeds would apply.

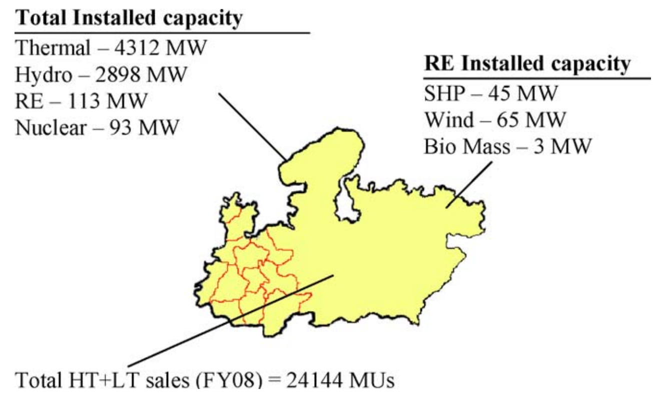


Fig. 6. Key highlights of power sector in Madhya Pradesh.

3. Case study

In this section of the paper, we discuss a case study analyzing the impacts and expected results, if such framework was to be established inside a state of India located in central part of India. Madhya Pradesh (MP) is chosen as the state for the case study. Fig. 6 highlights certain key parameters for the electricity sector in Madhya Pradesh.

MPERC, the SERC for Madhya Pradesh, was constituted by Govt. of Madhya Pradesh on 28.08.1998 under the ERC Act 1998. Following which the MPSEB (vertically integrated state utility) was unbundled into one generation company, one transmission company and three distribution companies. All the utilities formed post-unbundling are still owned by government. Table 2 provides information on key stakeholders of the power sector of Madhya Pradesh.

After studying the details of the electricity sector in Madhya Pradesh, we can propose and discuss the following RPO framework for the state of Madhya Pradesh.

Total potential of renewable based generation in the state of MP is over and above 7000 MW. Against this less than 2% of the total available potential for renewable energy source has been exploited. Madhya Pradesh has the 4th highest potential for renewable energy in India. However, in terms of % of the total potential extracted against the total potential available in a State, Madhya Pradesh is only above Orissa. Madhya Pradesh presently has an installed RE capacity of 113 MW. The present RPO target for the state of Madhya Pradesh is 10%. But with the total installed

Table 2
Information on key stakeholders of the power sector of Madhya Pradesh.

Organization	Functions
Govt. of MP	Owner of the Discoms, making investments in Discoms and formulating policies for power supply
MPERC	Independent institution which grants, revokes and amends Licenses for transmission and supply, fixes and regulates tariff, sets and enforces standards for the electricity industry and advices Govt. on matters concerning electricity industry
MPTransco	State owned utility which undertakes planning, investment and operation, of transmission infrastructure within the state
MPSLDC	State owned utility which ensure integrated operation of the power system in a state
MP Genco	State owned utility which undertakes planning, investment and operation of power generation activities for the state
Discoms	State owned utility which undertakes planning, investment and operation of distribution activities inside the state. There are three Discoms in total

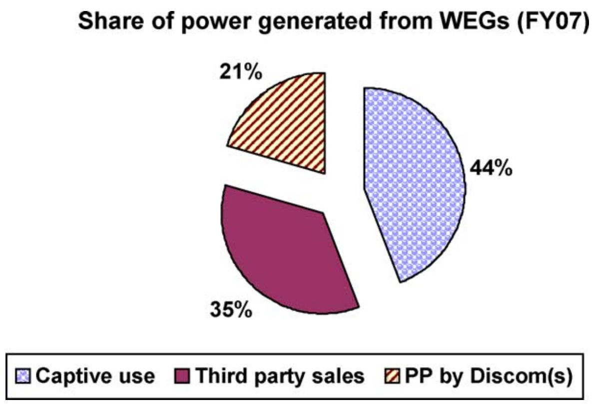


Fig. 7. Breakup of total energy sold by WEGs to different stakeholders.

capacity of 113 MW it can only meet up to 0.5% of its total LT + HT consumption. Also, most of the renewable energy capacity inside the state is for captive consumption or sale to third party. Sale to the utilities constitutes only 21% of total energy generated through renewable energy sources. Fig. 7 highlights the share of renewable purchase inside the state of Madhya Pradesh.

Following section discusses the RPO framework under discussion for the state of Madhya Pradesh.

3.1. Renewable Purchase Obligation

For the state of MP, technical potential assessment for renewable energy sources (especially wind based sources) is already done. It would take a time of 6 months to 1 year to install and start generating from RE sources. Hence, the RPO requirement can be proposed to be substantially increased to a higher level at the end of FY09 in order to give the Discom sufficient time to procure power from NCE sources.

A short-term target of achieving a 10% capacity of renewable energy sources has been quoted for India. RPO target of 10% has also been laid by Rajasthan Electricity Regulatory Commission (RERC) and Tamil Nadu Electricity Regulatory Commission (TNERC), while Maharashtra Electricity Regulatory Commission (MERC) has laid down a target of 6% RPO for FY10. MP has a peak load demand of 6500 MW, whereas it has a potential of 7000 MW generation from RE sources. In this context, a target of 10% RPO can also be proposed for MP (*Note*: MPERC has already declared RPO target of 10% for FY09, however no compliance procedure (RES or REC) has been put in place.). Keeping above two conditions in mind the following targets for RPO can be proposed for MP. The final targets proposed for the state of MP are as shown in Fig. 8.

Minimum electricity procurement from renewable energy sources should be different and based on the consumption of the entity(ies) and can be defined as follows:

- Minimum procurement of electricity from renewable energy sources = (actual annual LT sales + actual annual HT sales) × RPO target for the ensuing year.

RPO is also proposed to be levied on the OAC and CPP consumers. The minimum requirement for procurement of electricity from renewable energy sources for OAC and CPP consumers can be defined as follows:

- Minimum procurement of electricity from renewable energy sources for OAC = actual energy consumption as per the SEM meter installed at the Discom and OAC interface × RPO target for the ensuing year.
- Minimum procurement electricity from renewable energy sources for CPP consumer = (total actual energy consumption as per the SEM meter installed at the Discom and Captive interface + energy consumed from captive installed inside premises) × RPO target for the ensuing year.

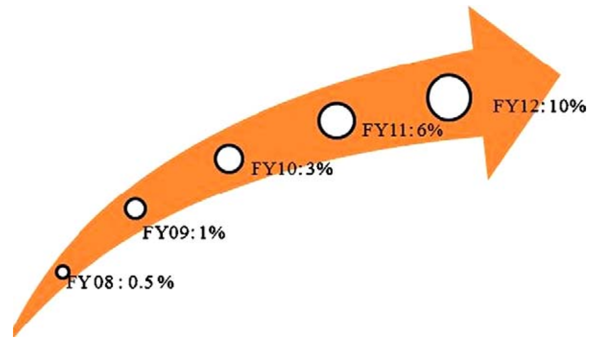


Fig. 8. RPO targets proposed for different financial years for the State of Madhya Pradesh.

It can also proposed that an OAC or CPP consumers with total annual electricity consumption less than 5 MUs shall not be required to meet the RPO target. This limit is imposed to leave out ECs with approximately 1 MW of demand or less from the purview of minimum RE procurement obligation. Exemption is proposed so that the framework is simplified and cost of administration is low.

3.2. Renewable Energy Surcharge

It is proposed that the payment of RES shall be made to STU. The penalty collected by STU can be credited to a fund which is to be utilized for creation of transmission system infrastructure (including evacuation infrastructure) of renewable energy power plants.

Penalty rate applicable to consumers is proposed to be slightly higher than the premium price which otherwise consumer would have paid towards the procurement of power from the costliest RE sources premium price can be defined as difference in the cost of procurement from costliest renewable energy source and the cost of procurement from the last generating station in the merit order dispatch of conventional generators (in India renewable based generation does not qualify for merit order dispatch). This price would basically be the cost avoided by not procuring from

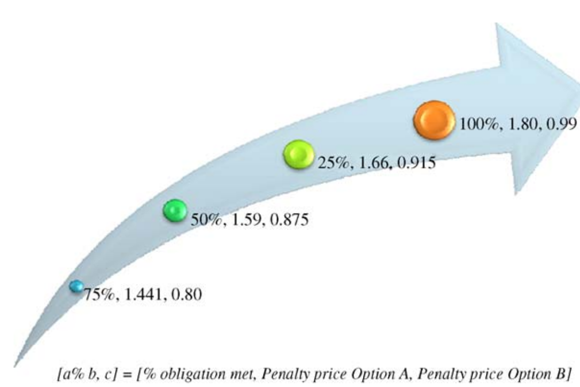


Fig. 9. Penalty price for FY08 based on assumptions.

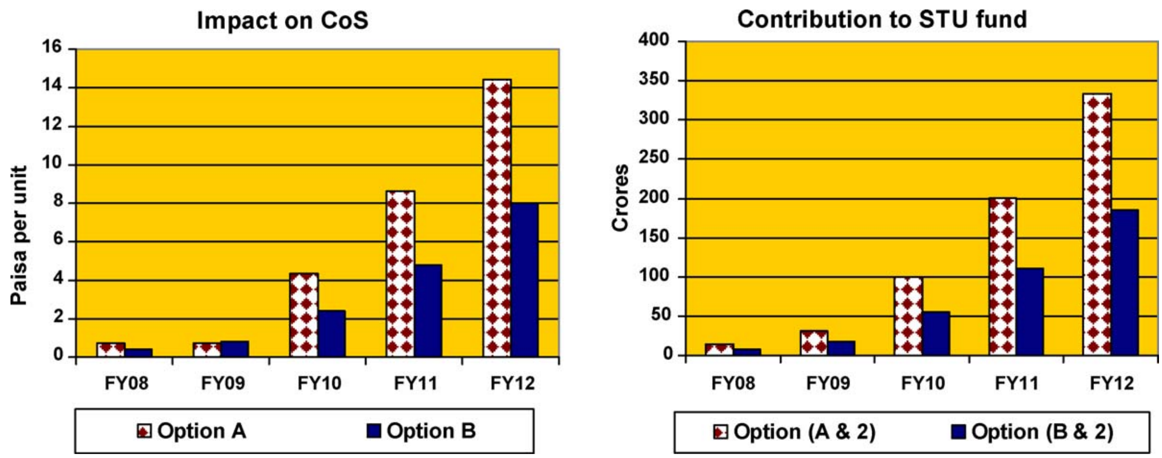


Fig. 10. Impact on Cost of Supply (LHS) and contribution to STU fund (RHS).

renewable energy sources. The following two options can be considered for the premium price:

- Pricing of penalty (option A): premium price = $(\alpha - \beta)^2$ = (3.97 − 2.66) = 1.31 Rs/unit [14,15].
- Pricing of penalty (option B): premium price = $(\mu - \beta)$ = (3.383 − 2.66) = 0.723 Rs/unit.

Penalty price in both option A and option B is 110% of the premium price calculated above. Along with the above penalty price, a graded penalty mechanism is proposed. It is proposed that eligible consumers who do not meet their RPO at all would be paying 25% extra penalty, while consumer meeting unto 25% of their RPO would pay 15% extra penalty and consumer meeting unto 50% of their RPO would pay 10% extra penalty. Based on these assumptions, penalty price for the year FY08 is as highlighted in Fig. 9.

3.3. Renewable Energy Certificates

Following are the attributes of REC proposed for the state of Madhya Pradesh:

- A single REC certificate can be issued to the eligible consumers (only) upon purchase of 1 kWh from renewable energy sources.
- Based on the expected demand–supply gap, it is suggested that ECs are not allowed to bank more than 25% of the REC issued to them in the ongoing financial year. Banked REC would lapse and expire if not availed in the following financial year. This will prevent hoarding of REC in order to extract higher prices from the REC.
- REC would be traded electronically in the State.
- Issuing body of these certificates can be the SLDC. SLDC can even provide a platform where the ECs can interact and indulge in the sale of REC.
- REC to be issued by SLDC every quarter based on the consumption data.
- RECs to be traded at a mutually agreed price between two parties.

[2] α = commission approved tariff of the costliest renewable energy source in the state for the concerned year (FY08) is equal to 3.97 Rs/unit for wind energy generators; β = per unit cost of the last generating station in merit order despatch for the state of MP for the concerned year (FY 08) is 2.66 Rs/unit; μ = commission approved levelised tariff of costliest renewable energy source in the state (as in FY08) is 3.383 per unit.

To minimize the effect of cross-subsidy loss, a higher percentage of proceeds from the sale of RECs would be given to the STU. The following two options for sharing the proceeds from the sale of REC:

- Option 1: 90% of the proceeds from REC sales to be given to the STU (rest 10% of the proceeds to be kept by REC seller).
- Option 2: 95% of the proceeds from REC sales to be given to the STU (rest 5% of the proceeds to be kept by REC seller).

In the next section we discuss the impact of the RPO on the state utilities framework proposed for the state of Madhya Pradesh.Impact of RPO framework

RPO mechanism would have financial implications on these consumers but consumers who are already purchasing power from these sources would gain an additional benefit of 4–15 Paise/unit depending upon the use of either option 1 or 2.

For the Discom(s), the RPO mechanism would mean that Discom(s) would be allowed to pass on the cost up to the premium price times the energy procurement obligation. This would lead to an increase in the Cost of Supply (CoS). Now the Discom(s) can either procures directly from the RE sources or purchase REC from other ECs. Let us assume the Discom(s) meet their RPO through the purchase of REC only. This way we would be able to analyze the maximum impact on the CoS. It would be safe to assume that the Discom(s) are purchasing RECs from the market at the penalty price. Taking these assumptions into consideration along with HT and LT sales figures up to FY12, we can calculated the net impact on the CoS as per the following formulae:

- Impact on CoS= $\eta \times \tau \times$ penalty rate/η = $\tau \times$ penalty rate.
- Contribution to the fund = % proceeds to be shared with STU under different options × total cost of RECs purchased by Discom(s)).

Financial impact of the penalty schemes proposed on the Discom(s), based on assumption mentioned above, is attached in Appendix A.

Also, we have calculated the impact of RPO on CoS and contribution to the STU fund by assuming that Discom(s) would meet all of their RPO by purchasing REC. However, if Discom(s) meet half of their RPO obligation by purchasing REC and other half by purchasing power from RE sources, then also impact of CoS as calculated above would not show a great deviation, however contribution to the REC fund would be reduced to half.

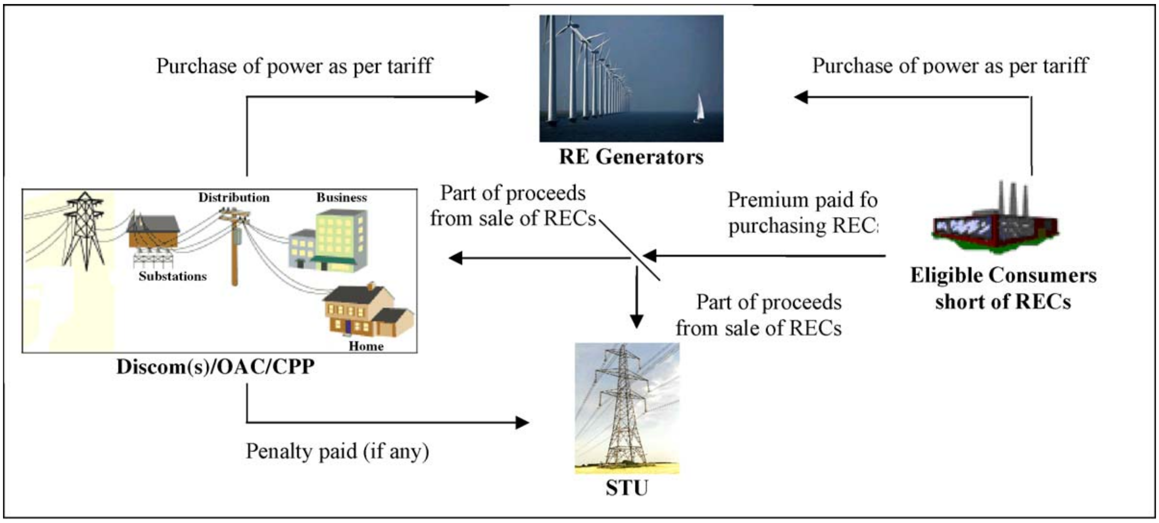


Fig. 11. Cash flows for the RPO framework proposed (assuming Discom is buying RECs).

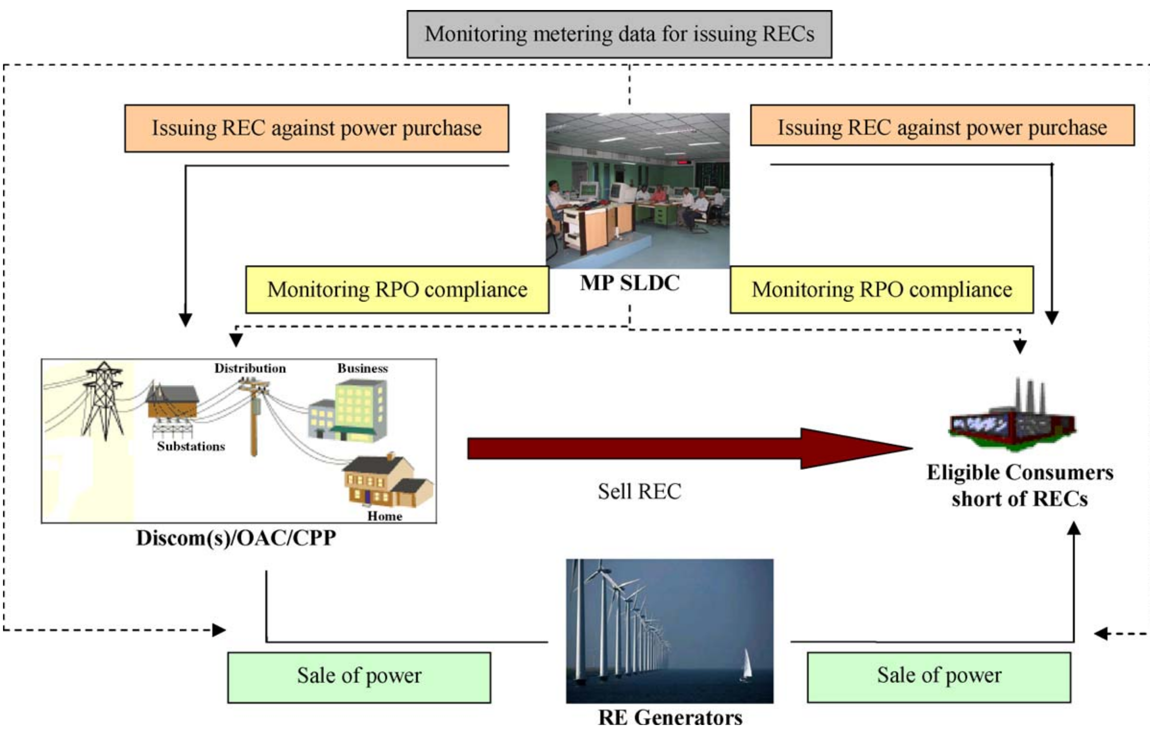


Fig. 12. RECs market structure.

Hence, impact on CoS because of the new RPO framework would not change by much even if the assumption (i.e. Discom(s) meets RPO via. purchase of RECs only) taken does not hold true. However, contribution to the STU fund is in direct relation to the assumption taken and hence will vary. Fig. 10 provides a snapshot summary of the table annexed.

Fig. 10 presents the impact of CoS and contribution to the STU fund for option A and option B from FY08 to FY12. Clearly option A would generate greater funds for the STU which can help promote renewable energy in the state. However, option A also has the highest impact on the average CoS in the state of Madhya Pradesh.

It can be seen that although option A would aggressively promote RE in the state, option B would result in lesser impact on the CoS. Only difference between option 1 and option 2 is that option 1 would provide higher incentive to the seller of REC and thereby increases the risk of losing HT consumers for the Discom(s). The net cash flow mechanism as proposed for this framework is attached in Appendix A.

4. Conclusion

It can be concluded from the discussions above that an RPO framework including the provisions of RES and REC market needs to be setup inside every state. Such a framework would help ensure compliance to the RPO targets setup by the respective SERCs. Success of the RPO framework would call for coordination between various stakeholders and organizations involved in the process including state utilities, SERCs, SNA, SLDCs and State Govt. Roles

Table 3
Impact of RPO framework proposed: case study.

			Option A			
			Option 1		Option 2	
FY08	*A*	21,449	*C*	14.7 Cr.	C	13.9 Cr.
	B	107.2	*D*	0.72 Paise	D	0.72 Paise
FY09	*A*	24,144	*C*	33.1 Cr.	C	31.3 Cr.
	B	241.45	*D*	0.72 Paise	D	0.72 Paise
FY10	*A*	25,739	*C*	105.7 Cr.	C	100.1 Cr.
	B	772.2	*D*	4.32 Paise	D	4.32 Paise
FY11	*A*	25,739	*C*	211.4 Cr.	C	200.3 Cr.
	B	1544.4	*D*	8.65 Paise	D	8.65 Paise
FY12	*A*	25,739	*C*	352.4 Cr.	C	333.8 Cr.
	B	2,574	*D*	14.41 Paise	D	14.41 Paise
			Option B			
			Option 1		Option 2	
FY08	*A*	21,449	C	8.2 Cr.	C	7.7 Cr.
	B	107.2	D	0.4 Paise	D	0.4 Paise
FY09	*A*	24,144	C	18.4 Cr.	C	17.4 Cr.
	B	241.45	D	0.8 Paise	D	0.8 Paise
FY10	*A*	25,739	C	58.7 Cr.	C	55.6 Cr.
	B	772.2	D	2.4 Paise	D	2.4 Paise
FY11	*A*	25,739	C	117.4 Cr.	C	111.2 Cr.
	B	1544.4	D	4.8 Paise	D	4.8 Paise
FY12	*A*	25,739	C	195.6 Cr.	C	185.3 Cr.
	B	2,574	D	8.0 Paise	D	8.0 Paise

A = total LT + HT sales* (MUs); *B* = procurement obligation (MUs); *C* = contribution to fund; *D* = increase in CoS.

and functions of different stakeholders involved in the RPO framework can vary from state to state depending upon the present capacity of the respective stakeholders to undertake such a process as well as upon the preparedness of the state itself.

Appendix A

Fig. 11 highlights the cash flow mechanism as projected for the case study of Madhya Pradesh.

Fig. 12 highlights the overall market structure envisaged for the case study of Madhya Pradesh.

Table 3 highlights the impact of the RPO framework proposed.

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